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WATER STORAGE

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A Report Submitted to the

Fifty-sixth Montana Legislature

by

Governor Marc Racicot

pursuant to
Montana Code Annotated, Sec. 85-1-704 (1991)

January 1999

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Abstract

Montana law requires the Governor to submit a report on water storage to the Montana Legislature each regular session. The *Governor's Report on Water Storage in Montana* is a review of state water storage policy and statutory criteria used to prioritize projects, and a summary of water storage rehabilitation and repair projects occurring during the previous two years. Project summaries provide information on background, financing, status, and strategy, where applicable. The report also includes new storage proposals, a table summarizing the projects, and a map indicating project type and location.

The rehabilitation of the Tongue River Dam remains the state's top priority, and completion of the project is projected for 1999. Funding carried forward from the 1997 Legislature will be used to complete the project. DNRC has requested $470,000 from the Water Storage Special Revenue Account to develop engineering specifications for the rehabilitation of two state-owned projects, Bair and Nevada Creek Dams. DNRC has applied for a Renewable Resource Program (RRGL) grant and loan package to the 1999 Montana Legislature to complete the Deadman's Basin Water Quality Improvement Project, a priority project currently ranked 8th among the RRGL applications.

The East Fork of Rock Creek Dam repair and rehabilitation was completed by DNRC in January, 1997, and the reservoir was filled to capacity by June, 1997. The rehabilitation of North Fork of Smith River Dam, as well as several other state-owned dams, is on hold and will be re-evaluated pending adoption of new dam spillway standards by DNRC's Dam Safety Program. The repair of Willow Creek Dam (Lewis and Clark County) was completed in the fall of 1997 by its owner, the U.S. Bureau of Reclamation.

Four publicly-owned projects, Fred Burr Lake Dam (Philipsburg), Tin Cup Dam (Tin Cup County Water and Sewer District), and Storm Lake Dam and Silver Lake Dams (Butte-Silver Bow) were rehabilitated in 1997-98, as well as several small private dams included in the report. Two emergency dam repair projects occurring in 1998, Fred Burr Lake Dam and Tin Cup Dam, were both completed before the end of the 1998 construction season.

The report also includes sections regarding two proposed reservoirs. The Ruby Creek storage study, classified as a pre-feasibility study in 1997, is inactive at this time pending a decision by the project study land-owner/applicants on issues related to property ownership in the area of the proposed storage site. The Big Lake Reservoir Study is in the initial stages of evaluation by the Big Hole River Watershed Committee.

Finally, seepage monitoring of dams classified as *high-hazard* is underway for both state-owned and non state-owned projects across the state. DNRC is requesting funding from the 1999 Legislature for seepage monitoring programs at four state-owned dams. Changes in the structural integrity of a dam can often be detected by changes in seepage behavior. A list of state-owned water storage projects can be found on the Internet at http://www.dnrc.mt.gov/wrd. Click your mouse on "dams and canals."

Montana Water Storage Projects

1999 Governor's Report

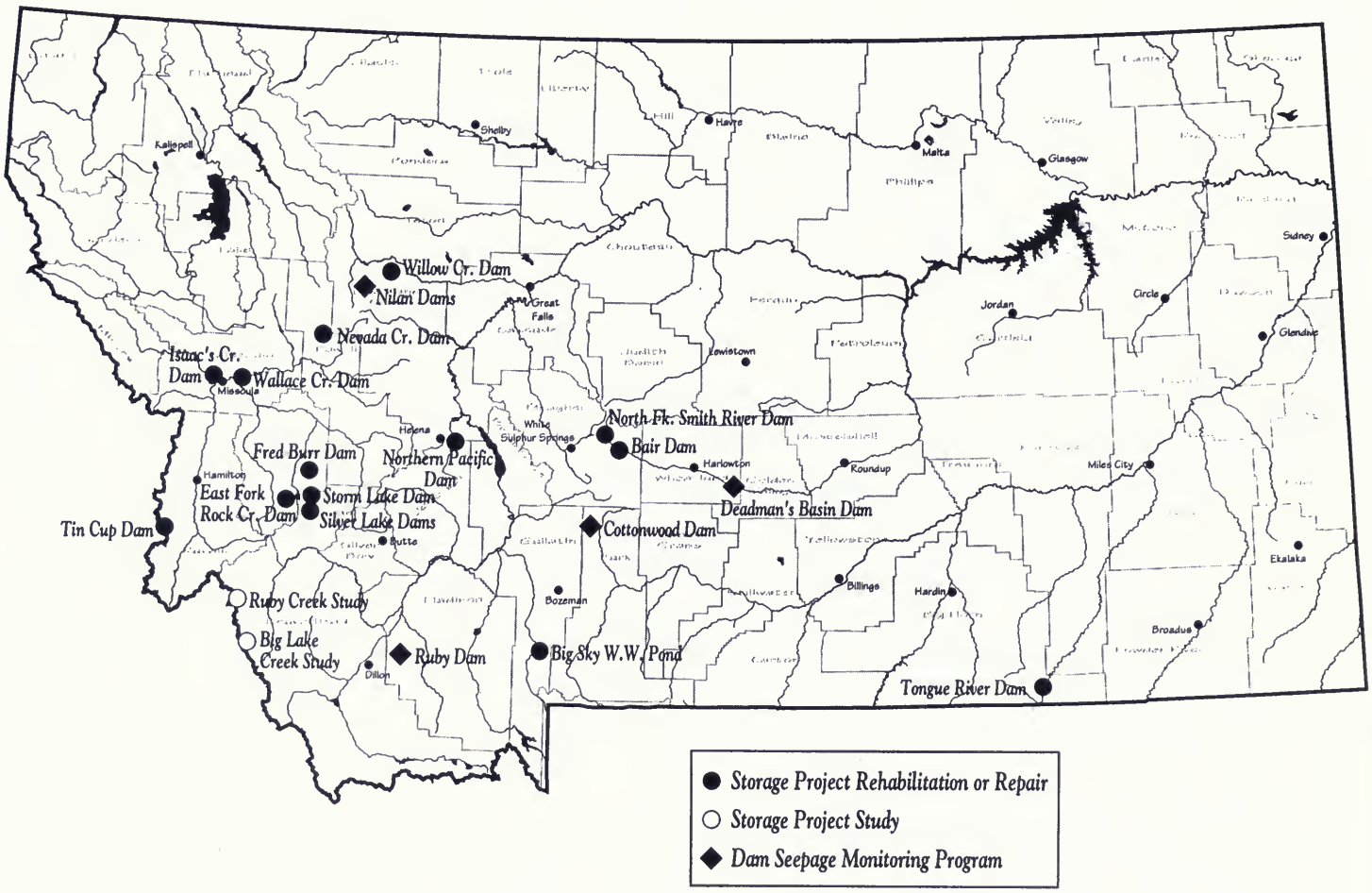

Table 1.
WATER STORAGE PROJECT SUMMARY
GOVERNOR'S REPORT 1999

Name/Use	County/Owner	Background	Plan	Cost**	Status	Complete
Tongue River Dam Rehabilitation	Big Horn State-owned	Built 1937-39; damage 1978,	Increase cap.; new spillways,	$16.5MSt. $32MFed.	Last phase 70% complete	April, 1999
Deadman's Basin Water Quality Improvement Project	Wheatland/Golden Valley/DBWUA*	Built 1934-40 Sedimentation Careless Creek	Re-routing of stored water	$500K RRGL 1999 Leg.	Nearly complete Last Phase remains	December, 2000
North Fork Smith River Dam Rehabilitation	Meagher State-owned	Built 1936 Unsafe 1980	Rehab. pend new spill std.	$1.04M authzd.	Draft design complete Hold	N/A
East Fork of Rock Creek Dam Repair and Rehabilitation	Granite State-owned	Built 1930 Sinkhole 6/96 Unsafe	Emer. rpr. outlet wrk. dam toe berm	$1.9M	Complete	June, 1997
Tin Cup Lake Dam Repair and Rehabilitation	Ravalli Tin Cup County Water Dist.	Built 1906 Unsafe 1980 New leak, 1998	Dam core; Spillway repair	$423K RRGL 1999 Leg.	storage restriction	1997 outlet rpr. 1998 leak rpr. rehab. pending funding
Willow Creek Dam Repair	Lewis and Clark U.S. Bureau of Reclamation	Built 1911 Mod. 1917,'41 Sinkholes '96	embnkmnt, oulet repair found. grout	$1.9M	Complete	October, 1997
Fred Burr Lake Dam Rehabilitation	Granite / Town of Philipsburg	1997 seepage increase	Outlt replcd. Spllwy recon	$284K	Complete	October, 1998
Storm Lake Dam Rehabilitation	Deer Lodge/Cnty Butte/Slvr. Bow	Built 1898 Rehab. needed	Spllwy, valves	N/A	Complete	October, 1998

Name/Use	County/Owner	Background	Plan	Cost**	Status	Complete
Silver Lake Dams Rehabilitation	DeerLodge / Cnty. Butte/Slvr. Bow	Built 1902 Rehab. needed	Spllwy, seep. control	N/A	Complete	August, 1997
Isaacs Creek Dam Repair	Missoula / private	Unsafe, irrig. stock, fishry.	Outlet pipe replcment.	$50K	Complete, Safety complies	Spring, 1997
Northern Pacific Reservoir Dam Rehabilitation	Jefferson / ASARCO	Unsafe, High hazard	Rehab.Tent. By yr. 2000	N/A	Storage restrcition	Unknown
Big Sky County Wastewater Storage Pond Dam Rehab.	Gallatin / Big Sky Water and Sewer District	High Hazard Ponds leaking	New Ponds built	N/A	Complete	November, 1997
Wallace Creek Dam Removal	Missoula / private Irrig., stock water	Built 1922 High Hazard	Removal	N/A	Complete	Summer, 1997
Bair Dam Rehabilitation Analysis	Meagher / State-owned	High Hazard, Spllwy. Unsafe	Rehab./ Dev. Eng. Specs.	$250K 1999 Leg.	Storage restricition '97	Fund Request 1999 Legislature
Nevada Creek Dam Rehabilitation Analysis	Powell / State-owned	High Hazard, Spllwy. Unsafe	Rehab./ Dev. Eng. Specs.	$300K 1999 Leg.	Leakage spllwy. unsafe	Fund Request 1999 Legislature
Big Lake Creek Reservoir Study	Beaverhead / N/A	Big HoleWshed Comm. Study	Drilling, Geo-Tech	$73K to drill, rpt	Pending funding	N/A
Ruby Creek Water Storage Study	Beaverhead / N/A	Wat. avail. stdy 1994-'97	N/A	Est'96@ $1.2M	Inactive	N/A

* Deadman's Basin Water Users Association

** Cost estimates are rounded up; funding typically from variety of sources-see project summaries

I. Introduction

The Governor is required by statute to submit a report on water storage to the legislature each regular session. The *Governor's Report on Water Storage in Montana*: reviews state water storage policy and statutory criteria used for prioritization of proposed projects; identifies water storage projects proposed for development, including the rehabilitation of existing projects and progress on new projects; and summarizes water storage projects in progress during the previous two years. Project summaries provide information on background, status, and implementation strategy, where applicable. The report includes a table summarizing the projects and a map indicating each project type and its location.

II. Water Storage Policy and Statutory Criteria

The 1991 Montana Legislature passed into law a policy on water storage to determine when storage is the best solution for solving specific water supply problems. The policy identifies criteria for use in ranking state-funded projects (Sections 85-1-701 through 704 MCA), when storage is determined to be the best alternative. This law is based on the water storage section of the state water plan, developed over a two-year period by three technical committees and the State Water Plan Advisory Council, with participation and guidance from the Governor's Office and the Legislative Water Policy Committee. Montana's water storage policy is as follows:

> *The legislature recognizes that water resources needs are growing, existing water facilities are aging and in need of repair, and new water storage projects have become more difficult to complete. Other types of actions will be needed to solve many emerging problems, but if storage is the best way to meet growing water needs and solve problems, it should be actively pursued.*

In determining the best solution for a particular water management problem, the state shall:

- *a. carefully define the problem;*
- *b. identify all options to solve the problem, including water storage;*
- *c. determine whether water is physically and legally available to solve the problem; and*
- *d. select the option that best meets the following criteria:*
  - *i. technical feasibility*
  - *ii. financial feasibility*
  - *iii. economic feasibility*
  - *iv. political feasibility*
  - *v. legal feasibility, and*
  - *vi. environmental feasibility*

Water Storage Project Prioritization Policy

The statute calls for this report to the legislature and describes its requirements. The statute also identifies different criteria to be used to prioritize new water storage projects, storage rehabilitation projects, and budget priorities for the allocation of state water storage development funds. Section **85-1-704 Prioritization of water storage projects - governor's report**, states:

(1) The governor shall submit to each regular session of the legislature a report identifying specific water storage projects proposed for development, including the rehabilitation of existing projects and new project proposals. The report must contain:

a) a list of water storage project priorities;

b) an implementation strategy for each priority project that identifies the resources (including specific budget requests), government actions, and other actions needed to accomplish the project; and

c) a progress report on the development of water storage projects during the previous 2 years.

(2) In setting priorities among new water storage projects, the governor shall consider whether a project:

a) solves a severe water problem;

b) provides multiple uses and benefits;

c) provides for public uses;

d) shows strong evidence of broad citizen support;

e) is able to obtain non-state sources of funding;

f) protects and seeks to enhance social, ecological, cultural, aesthetic values;

g) improves local and state economic development;

h) could resolve Indian and federal reserved water rights issues;

I) supports water conservation activities; and

j) promotes the use of water reserved under Montana law.

(3) In setting priorities among water storage rehabilitation projects, the governor shall consider whether the project:

a) is needed to protect public safety;

b) has impacts if not repaired or rehabilitated; and

c) accomplishes the goals listed in subsection (2)(a) through (2)(j).

(4) In establishing budget priorities for the allocation of state water storage development funds:

a) First preference must be given to projects that resolve threats to life and property posed by high-hazard facilities that are in an unsafe condition;

b) *Second preference must be given to projects that improve or expand existing water storage facilities; and*

c) Third preference must be given to the planning and construction of new water storage facilities.

Renewable Resource Grant and Loan Program (RRGL)

Montana's RRGL program reviews a variety of project proposals prior to each legislative session. Resource-related projects that conserve, manage, develop, or initiate the beneficial use of a renewable resource are eligible. Grant applications for water storage-related proposals receive a high priority. The RRGL program ranks projects that promote water storage priorities established by the State Water Plan and the water storage statute.

Water Storage Special Revenue Account

Dams classified as ***high hazard*** that are in ***unsafe*** condition receive first preference for use of funds from the state's Water Storage Special Revenue Account (Section 85-1-631 MCA). This account was designated by the 1991 Legislature to allocate 25 percent of the grant funds available, or $500,000 each biennium, under the Renewable Resource Grant and Loan (RRGL) program, to be used exclusively for water storage projects. This biennium, DNRC is requesting $470,000 from the Water Storage Special Revenue Account to develop engineering design specifications for the rehabilitation of Bair and Nevada Creek dams.

Water Storage Projects Prioritized

The following projects are prioritized using the criteria in Sec. 85-1-704 (4) MCA.

State-owned Rehabilitation Projects

1. Tongue River Dam Rehabilitation
2. Deadman's Basin Water Quality Improvement Project
3. Bair Dam Rehabilitation Analysis
4. Nevada Creek Dam Rehabilitation Analysis
5. North Fork of Smith River Dam Rehabilitation

Rehabilitation Projects, Not State-owned

1. Tin Cup Lake Dam Rehabilitation

New Project Proposal

1. Big Lake Reservoir Study

Justification for Project Prioritization

The following rehabilitation projects are prioritized by DNRC according to the criteria identified by Montana Code Annotated (MCA) listed at the beginning of this report.

State-owned Rehabilitation Projects

1) Tongue River Dam Rehabilitation

The rehabilitation of the Tongue River Dam has been the state's highest water storage priority since 1990. A moderate flood in 1978 caused $1,000,000 damage to the spillway and demonstrated the potential for disaster on a larger scale. The dam is classified *high-hazard* because its failure could jeopardize 7,000 human lives. The dam was also found to be *unsafe* due to an inadequate spillway. The dam's rehabilitation and enlargement will contribute to the settlement of the federally reserved water rights of the Northern Cheyenne Tribe. In 1995, $3.5 million in state funding was budgeted for the Tongue River Dam rehabilitation project. Approximately $32 million in federal funds has been appropriated for the Tongue Dam project. The project meets the first and second water storage priority criteria: it resolves threats to life and property posed by a high-hazard facility in unsafe condition; and improves or expands an existing storage facility.

2) Deadman's Basin Water Quality Improvement Project

Deadman's Basin Reservoir is owned by DNRC and operated and maintained by the Deadman's Basin Water Users Association (DBWUA). Water is released from the project through two canals: the Careless Creek Canal and the Barber Canal. The proposed rehabilitation project will increase the capacity of the Barber Canal from 200 to 300 cubic feet per second (cfs). This will allow a decrease in flow in Careless Creek and the Careless Creek Canal from 250 to 150 cfs, which will enable the project to meet water quality standards in Careless Creek. The EPA has apprised DBWUA that these standards are routinely violated in Careless Creek by erosion caused by the 250 cfs flow released from the dam. DNRC has submitted an application to the Renewable Resource Grant and Loan (RRGL) Program and 1999 Legislature for $501,100 to complete the rehabilitation of the Barber Canal. State water project prioritization policy gives second preference to projects that improve or expand existing facilities. Completion of the project is expected in December, 2000.

3) Bair Dam Rehabilitation Feasibility Analysis

The DNRC State Water Projects Bureau has submitted a request for $250,000 in funding to the 1999 Legislature, through the Executive Planning Process (EPP), to develop engineering design specifications for Bair Dam (Meagher County) and its spillway to determine the most economic rehabilitation alternative available for the project. Bair Dam

is classified as a *high-hazard* dam, since its failure could result in the loss of human life. The dam spillway is in poor condition, does not meet interim design standards, and will likely not meet the new standards when they are adopted. A permanent water storage restriction is currently in place until the spillway can be rehabilitated. The project is a required step in meeting water storage statute first priority criteria: it resolves threats to life and property posed by a high-hazard facility in an unsafe condition.

4) Nevada Creek Dam Rehabilitation Feasibility Analysis

DNRC State Water Projects Bureau has submitted a request for $300,000 in funding from the 1999 Legislature, through the Executive Planning Process, to develop engineering design specifications for Nevada Creek Dam (Powell County) and its spillway to determine the most economic rehabilitation alternative available for the project. The dam spillway is in very poor condition and may not be able to safely route the required design flood. The spillway will most likely require replacement and at the least, significant structural improvements. A stability analysis of the dam is needed since there is uncontrolled seepage exiting both abutments and water is flowing from the dam embankment toe drain. The project would meet the storage statute first priority criteria: it resolves threats to life and property posed by a high-hazard facility in an unsafe condition.

5) North Fork Smith River Dam Rehabilitation

The North Fork Smith River Dam (Meagher County) was designed and constructed in 1936 and is owned by DNRC. It is operated and maintained by the Smith River Water Users Association through water purchase contracts. North Fork Dam classified as *high-hazard* since its failure could result in loss of human life. HKM Associates has completed a draft feasibility report for rehabilitation of the dam to meet current state dam safety standards. At the direction of DNRC, HKM has ceased further work on the feasibility report, pending adoption of new spillway standards by DNRC's Dam Safety Program. The new standards are expected to have implications for dam spillway design that will tend to reduce the cost of dam rehabilitation. Once revised spillway standards have been adopted, DNRC will re-evaluate the rehabilitation needs of the project and the dam's former status as *unsafe*. The North Fork of Smith River Dam currently meets interim Montana dam safety standards. If the spillway is determined to be unsafe after adoption of the new spillway standards, the project would meet the storage statute first priority criteria: it would resolve the problems posed by a high-hazard facility in an unsafe condition.

Rehabilitation Project Not Owned by State

1) Tin Cup Lake Dam Rehabilitation

A $302,204 RRGL loan was approved by the 1993 Legislature for the dam's rehabilitation. The dam was found to be *unsafe* and is classified as *high-hazard* due to the potential for loss of life in the event of failure. The dam is located within the boundaries of the Selway-Bitterroot Wilderness Area and supplies water to 1,300 acres of farmland in the Bitterroot Valley. The dam's owner, the Tin Cup Water Company formed a county water and sewer district in 1998, making it a public entity and eligible to qualify for state program loans.

In 1998, significant seepage was discovered in the dam toe, necessitating an emergency repair. The dam, as modified by the emergency repair, is now in safe condition, but can store only about one-third as much water as it could prior to the 1998 emergency repair. The water district is currently evaluating its financial position with respect to future plans for Tin Cup Dam and the unanticipated high cost of the emergency repair work. The Tin Cup County Water and Sewer District application to the RRGL Program for a grant to rehabilitate the Tin Cup Dam is currently ranked 57th.

New Project

1) Big Lake Water Storage Study

The proposed project site is located approximately 14 miles south and 11 miles west of the town of Wisdom in the Big Hole River Valley. The site is located at Twin Lakes, in the Beaverhead National Forest. The lakes are supplied by Big Lake Creek, a perennial stream originating on the Continental Divide. The Big Hole River Watershed Committee is the project sponsor. The Bureau of Reclamation performed a preliminary geological evaluation of the site in 1998, and concluded that without an exploratory drilling program, which would reveal the underlying geology of the area, it cannot make a determination as to the feasibility of the site for a water storage project. Cost of the drilling is estimated at $73,000. The Big Lake Storage Project could provide water to augment seasonal low streamflow in the Big Hole River near Wisdom, which negatively impacts fluvial arctic grayling. Several environmental concerns must be addressed before a feasibility study can proceed. The project would meet the third priority of the storage statute: planning and construction of new projects.

III. Water Storage Project Classification and Terminology

It is important that the reader have some background and basic understanding of some principles and terms related to dam safety classification used in this report. Standards used by the U.S. Army Corps of Engineers classify a dam spillway as *unsafe* if it would be unable to route a certain percentage of a probable maximum flood (PMF), or if the dam's structural integrity has become compromised since construction. A PMF is the flood that would result from a combination of extreme meteorological (storm) and hydrological conditions. The pending adoption of dam spillway standards by the Montana Dam Safety Program may result in changes to dam design standards and criteria used for the *unsafe* designation. The Dam Safety Program is now operating with interim spillway standards.

The state's highest priority for repair and rehabilitation is assigned to dams classified as *high-hazard* and *unsafe*. The *high-hazard* classification should not be confused with an assessment of a dam's structural integrity or condition. A dam is classified as *high-hazard* if its failure has the potential for loss of human life, regardless of its current structural condition. All existing storage projects addressed in the *Governor's Report* are classified *high- hazard*, and will remain classified as *high-hazard* following the completion of any proposed work. All dams under rehabilitation in 1997-98 were determined to be *unsafe*.

Repair of a project usually refers to emergency action taken to resume dam function to original design capacity or at a reduced, but safe level. *Rehabilitation* involves upgrading existing projects to comply with or exceed current design standards and often includes repair work. Design standards have evolved considerably since the construction of most of the state's dams and repair alone may not bring a facility up to current design standards. The storage capacity of a project is sometimes increased during rehabilitation, especially if enlargement is determined to be a cost-effective alternative.

IV. Water Projects Summarized

This section describes each repair and rehabilitation project and water storage proposal in detail. Project descriptions include information on funding, background, status, and implementation strategy, where applicable. A number of rehabilitation projects started during the last biennium were completed in 1997-98, and several are ongoing. Engineering design analyses are proposed for two state-owned storage projects. One rehabilitation project being planned during the last biennium is in a "hold" status pending the adoption of revised dam spillway standards that may have a bearing on future dam spillway design requirements. There were two emergency repair projects in 1998, both completed before the conclusion of the 1998 construction season. One proposed project classified as *new* in the 1997 water storage report is now inactive, following the completion of a pre-feasibility study and pending a decision by the sponsors. A new reservoir study project, initiated in 1997, is now in the pre-feasibility stage.

Rehabilitation and Repair Projects

This section contains current information concerning projects that were in progress when reported in the 1997 *Governors Report on Water Storage*, or were started during the past two years. Some projects have been completed during the last two years, while work on others will continue into the next biennium. Two emergency dam repair projects, both occurring and completed in 1998, are reported in this section as well.

Tongue River Dam Rehabilitation

The Tongue River Dam is owned by the State of Montana and is located in southeastern Montana, 10 miles north of the point where the Tongue River flows into Montana from Wyoming. The Tongue River carves a 265 mile-long valley from its headwaters in Wyoming's Bighorn Mountains to its confluence with the Yellowstone River at Miles City, Montana.

Description

The existing dam embankment is 91 feet high and 1,824 feet long, with a crest width of 55 feet. The reservoir has a surface area of about 3,200 acres, and following the completion of rehabilitation, a usable capacity of 79,071 acre-feet (af) of water, making it the largest state-owned water project, in terms of storage capacity, in the state. The reservoir measures approximately eight miles in length and averages one-half mile in width. The original reinforced concrete spillway was 350 feet wide at its crest and 100 feet wide at its base. The new reinforced concrete principal spillway, to be located in the left abutment, has a crest width of 150 feet, and the auxiliary spillway has a crest length of 650 feet.

The new outlet works system consists of a nine-foot diameter principal outlet and an auxiliary outlet measuring 16-feet in diameter. The total combined design discharge is 3,200 cfs. The rehabilitation of the project, planned from 1996 through 1999, added a new auxiliary spillway, reconstructed the principal spillway, constructed a new principal outlet and rehabilitated the existing auxiliary outlet, which served as the original outlet works. The rehabilitation of the dam resulted in raising the spillway crest by four feet to provide additional water for settlement of the Northern Cheyenne Tribe Reserved Water Rights.

As an interstate river, the Tongue River is subject to the terms of The Yellowstone River Compact between Montana, North Dakota, and Wyoming. The Tongue River project provides a reliable supply of water for the irrigation of 15,000 acres of land between the dam and Miles City. Nearly all the water used for irrigation supports alfalfa, feed barley, and pasture for the livestock industry. Irrigation water under contract from the project totals 39,300 acre-feet for irrigation which includes 7,500 acre-feet dedicated for use by the Northern Cheyenne Tribe. The state fish hatchery in Miles City has contracted for 650 acre-feet and the St. Labre Mission in Ashland has contracted for 50 acre-feet of water for a total of 40,000 acre-feet of contracted water.

Background

The dam developed structural problems during a moderate flood in May 1978, when water being spilled severely eroded areas behind each of the wingwalls at the spillway's lower end. This damage took place during a spillway flow of 6,800 cfs. The spillway originally was designed to accommodate a flow of 62,500 cfs.

A Corps of Engineers dam inspection resulted in the Tongue River Dam's classification as a *high-hazard* dam. The Corps further determined that the dam was *unsafe*, due to the inability of its spillway to accommodate large flows. The approximately $1 million in damage to the spillway during the flood of 1978 compromised the Tongue River Dam and reaffirmed the magnitude of the threat posed by a large-scale flood.

The enlarged Tongue River Reservoir is a critical element to the settlement of the Northern Cheyenne Tribe's federal reserved water rights. A compact negotiated between the Tribe and the state provides up to 20,000 acre-feet of additional water, annually, to the Tribe from the proposed dam rehabilitation and reservoir enlargement. It also protects the Tribe's existing contract for 7,500 acre-feet of water, annually. The legal settlement and the state's plan called for construction of a new spillway with an additional four feet in crest height. Legislation to ratify the settlement and authorize federal cost-share funding for the project was passed by Congress and signed by President Bush in 1992.

The rehabilitation of the Tongue River Dam was ranked first in the *1995 and 1997 Governors Report on Water Storage in Montana*. Estimated regional economic costs resulting from failure of the dam, including flood damage, would range from $300 to $500 million. The Northern Cheyenne Tribe would lose its 7,500 acre-feet of contracted water indefinitely. Important wildlife habitat also would be lost for a number of years. Since 1978, DNRC has operated the reservoir at reduced capacity to avoid use of the spillway.

Federal legislation required the Secretary of the Interior to enter into a cooperative agreement for planning, design, construction, and environmental compliance on the Tongue River Dam Project. That agreement was finalized June 16, 1994. Environmental compliance was complete by March 1996, with publication of the final environmental impact statement.

The 1995 Legislature granted continuing appropriation authority of $3.5 million for the Tongue River Dam Rehabilitation which included $1,746,000 from the Water Storage Special Revenue Account (the entire proceeds), and $1,754,000 from the Renewable Resource Grant and Loan (RRGL) state special revenue account. DNRC projects that it will spend approximately $16.5 million on the Tongue Dam project before completion. This includes a $11.5 million loan from the Northern Cheyenne Tribe to the State of Montana. Federal funding totals about $32 million for construction, mitigation, and enhancement. Costs to the federal treasury for the Tongue River Dam Rehabilitation Project and the settlement of the Northern Cheyenne Tribe reserved water rights will total about $63.4M.

Current Status

Construction began in late July of 1996 and will be completed in April, 1999. Construction was divided into three phases and is currently in the third, or final phase. The fish and wildlife enhancement project and the state park and mitigation construction projects are currently in progress. The project remains on schedule and under budget in 1991 dollars.

Implementation Strategy

Phase One of the project consisted of building roads, stockpiling aggregate, and site preparation. Construction on Phase Two began in January, 1997 and included overlaying 650 feet of the existing earthen embankment dam with a stair-stepped, down slope, roller-compacted concrete emergency spillway and stilling basin. A 400-foot temporary steel flume, capable of carrying 1600 cubic feet of water per second, was also constructed.

Construction on Phase Three, the largest phase of the Tongue River Dam Project, began in September of 1997 and is about 70 percent complete. Phase Three involves construction of a four-cycle, mini-labyrinth weir primary spillway and stilling basin; construction of a new primary outlet tunnel, gates, and stilling basin; and reconstruction of the existing outlet works. Demolition of the pre-existing primary spillway, construction of the new outlet tunnel, and stabilization of the foundation were accomplished in FY 1998. Phase Three is scheduled to be completed in April, 1999.

Fish and wildlife enhancement projects were selected by the U.S. Bureau of Reclamation, the Northern Cheyenne Tribe, and DNRC in August, 1996. Most of the federal funds were directed toward projects on the Northern Cheyenne Reservation, and state funds were directed toward projects outside of the reservation. The state is responsible only for off-reservation projects, including the installation of a fish screen at the irrigation diversion below the dam, and construction of a wetland south of the reservoir. Construction on the irrigation fish screen began October 1, 1998, and is scheduled for completion by May, 1999.

The State Park and Mitigation projects involve reconstruction of a new state park to replace the existing park, which will be inundated by the new reservoir level, and construction of a wetland and protection of embankments along State Highway 314 and County Road 25. Bids were received in March, 1998 and a contractor was selected in May, 1998. Work is currently underway and scheduled for completion in November, 1998.

Summary

The rehabilitation of the Tongue River Dam was ranked first in priority in the *1995* and *1997 Governors Report on Water Storage in Montana*, and is ranked first for the 1998-99

biennium. The Governor's Office and DNRC have assigned a high priority to rehabilitating and enlarging the Tongue River Dam due to its *unsafe* condition and *high-hazard* status. The repair and enlargement of the dam will eliminate the dam's current *unsafe* status resulting in a safe structure and an increase in firm annual yield.

The Tongue River project offers a viable solution to several water storage issues in southeastern Montana, satisfies the storage policy objectives of the laws of Montana, and serves to settle federal reserved water right claims of the Northern Cheyenne Tribe. The project supplements the supply of water in a semi-arid agricultural region, provides more opportunities for recreation, and is environmentally compatible. Finally, the project is a cost-effective solution, since it both increases water storage capacity and addresses a potentially hazardous situation.

Deadman's Basin Water Quality Improvement Project

Deadman's Basin is a state-owned water storage and canal project located 22 miles east of Harlowton in eastern Wheatland and western Golden Valley counties.

Description

The project, operated and maintained by the Deadman's Basin Water Users Association (DBWUA), impounds 72,220 acre feet of water and irrigates approximately 26,000 acres. Deadman's Basin releases water through two outlet canals: the Careless Creek Canal and the Barber Canal. The Lower Musselshell Conservation District has determined that water quality on the lower Musselshell River can be improved by decreasing flow rates in the Careless Creek outlet canal, thereby reducing erosion and sediment transported in Careless Creek.

To maintain historic flow releases from storage, the flow rate will be increased in Barber Canal to compensate for the loss in flow in Careless Creek Canal. Increased flow rate in the Barber Canal will require canal rehabilitation and enlargement. The Deadman's Basin Water Quality Improvement Project will increase the current capacity of the Barber Canal from 200 cubic feet per second (cfs) to 300 cfs and decrease flow in the Careless Creek Canal from peak discharges of 250 cfs to less than 150 cfs.

Background

The flow of Careless Creek Canal is routed through Careless Creek for about six miles before reaching the Musselshell River. Release of clear stored water into Careless Creek has resulted in considerable streambank erosion and transport of sediment downstream to the Musselshell River. This plan involves releasing a larger percentage of the water to the Musselshell River through the Barber Canal, which discharges directly to the river. Enlargement of several drop structures will be required and the canal must be stabilized to accommodate the higher flows.

The rehabilitation project is comprised of four phases. The first phase was initiated in 1993. A failed drop structure provided an opportunity for replacement with a 300 cfs structure. This phase was successfully completed through a joint effort by Golden Valley Agricultural Stabilization and Conservation Service (now FSA), DBWUA, DNRC, and the Soil Conservation Service (now NRCS) in December of 1993.

DNRC received a RRGL loan of $111,081 and grant of $47,919 in 1995 for construction to enlarge Barber Canal and to contract consulting engineering services to develop a rehabilitation plan for the existing concrete structures in the Barber Canal. Total project cost is $191,594. DBWUA contributed $32,675 to the project cost.

Current Status

The second phase of the project, which began in October, 1998, is the repair and enlargement of the stilling basins below existing structures, and the armoring of outside bends of the Barber Canal. The third phase, now complete, involved engineering design for increasing the capacity of the three existing drop structures that limit flow capacity. The fourth, or final phase of the project will increase the current capacity of the Barber Canal from 200 cubic feet per second (cfs) to deliver 300 cfs to the Musselshell River. The enlargement requires widening the Barber Canal in places, enlarging the drop structures, and installing a larger culvert at the canal's intersection with U.S. Highway 12.

Implementation Strategy

Repair and enlargement of the stilling basins below existing structures and armoring of the outside bends of the Barber Canal began in October, 1998, and is scheduled for completion by December, 1998. The feasibility study and design for increasing flow capacity of the three existing drop structures that limit flow capacity has been completed by the Natural Resource Conservation Service. The fourth phase, upgrading the Barber Canal to deliver 300 cfs to the Musselshell River, will be completed by December 2000. DNRC has submitted an RRGL grant and loan application of $501,100 for the completion of phase four of the project for consideration by the 1999 Montana Legislature.

Summary

The Deadman's Basin Water Quality Improvement Project was ranked fifth in 1995 and second in 1997 for the *Governor's Report on Water Storage in Montana*. This project is preferable to the more costly alternative of stabilizing the streambanks and channel of Careless Creek to accommodate higher flows and prevent extensive erosion and water quality degradation. This project supports state water policy objectives of integrating water quality and quantity management by encouraging water quality improvement by local water users. The project is well-supported by the local community.

North Fork Smith River Dam Rehabilitation

The North Fork of the Smith River Dam and its reservoir, Lake Sutherlin, are owned and managed by DNRC, and are located about ten miles east of White Sulphur Springs in Meagher County.

Description

The dam measures 84 feet high and 1,300 feet long at its crest, and stores 11,500 acre-feet of water at the spillway crest. The average storage is 9,000 acre-feet. The water is used to irrigate 11,000 acres of project land and provides considerable recreation opportunities.

Background

The Smith River Dam was designed and constructed in 1936 to meet the dam safety standards of that time, and is operated and maintained by the Smith River Water Users Association through water purchase contracts. The Army Corps of Engineers (Corps) inspected the dam in 1980, under the National Dam Inspection Program, and classified it as *high-hazard* because its failure could result in loss of human life. The Corps declared the dam *unsafe* due to inadequate spillway capacity to route the probable maximum flood.

Current Status

During the spring of 1989, DNRC contracted with consulting engineers HKM Associates to perform a design study for upgrading the dam to meet current federal and state dam safety standards. The study includes a geotechnical investigation, a flood hydrology analysis and subsequent spillway design, a water availability analysis, a rehabilitation plan with cost estimates for various alternatives, an environmental assessment, and a project evaluation that addresses the financial and economic feasibility of rehabilitation. Final hydrology, geotechnical, and cultural resources reports have been completed. To date, HKM has completed a draft design report. The project spillway capacity presently meets the Montana Dam Safety Section interim spillway standards.

Implementation Strategy

At the direction of DNRC, HKM has ceased further work on the design analysis, pending adoption of new spillway standards by DNRC's Dam Safety Program. The new standards are expected to have implications for dam spillway design that will tend to reduce the cost of dam rehabilitation throughout Montana.

An amount of $358,000 was re-directed from the $1,393,467 loan approved and authorized for the North Fork of Smith River Dam to fund the rehabilitation of Petrolia Dam, a high priority project. The remaining balance of $1,035,467 has been re-authorized for the North Fork Smith River Dam Project, pending re-evaluation by DNRC of the scope of work necessary for the North Fork Smith River Dam.

Summary

Once revised spillway standards have been adopted, DNRC will re-evaluate the rehabilitation needs of the project and the dam's former status as *unsafe*. The North Fork of Smith River Dam currently meets interim Montana dam safety standards. The project would meet the storage statute first priority criteria, if the spillway is determined to be unsafe after adoption of the new spillway standards: it would resolve the problems posed by a high-hazard facility in unsafe condition.

East Fork of Rock Creek Dam Repair and Rehabilitation

East Fork of Rock Creek Dam is owned by the State of Montana and is located in south Granite County, at the headwaters of the East Fork of Rock Creek, about 30 miles west of Anaconda. The East Fork flows northwesterly for 13 miles before joining the Middle Fork and the West Fork to form Rock Creek, a tributary of the Clark Fork River.

Description

The earthfill dam is 25 feet wide at its crest to over 500 feet wide at its base, 83 feet high, and 1075 feet in length at the crest. The reservoir has a storage capacity of slightly more than 16,040 acre-feet and a surface area of 420 acres. East Fork Dam is classified as *high hazard*, since in the event of a failure, human life would be threatened. During the irrigation season, reservoir water is routed to the east, into the Flint Creek drainage, via a canal that traverses a mountain side before emptying into Trout Creek, a tributary of Flint Creek. During the remainder of the year, water spilled or released, is allowed to flow through a headgate into the East Fork drainage.

Background

Built in 1938, East Fork Dam is owned by the state, managed by DNRC, and used primarily as a supply for the irrigation of 18,457 acres by the 44 irrigators of the Flint Creek Water Users Association (Association). On June 29, 1996, a Forest Service employee observed muddy water flowing from the main embankment of East Fork Dam. DNRC, the association, and the Granite County Sheriff were notified and arrangements were made for 24-hour per day monitoring of the dam. Reservoir releases were increased immediately to reduce pressure against the dam and reduce the potential of a breach, or failure. The area downstream of the dam was evacuated until the reservoir contents were reduced to a safe level. Design investigations began almost immediately and construction of the repairs began in early August.

Implementation Strategy

The repair and rehabilitation plan included the following steps:

- Replacement of the 12-inch diameter metal main drain pipe with a plastic 12-inch pipe and replacement of the original gravel and sand filter with a new graded filter;
- Installation of a new drain pipe on the east side of the dam to drain seepage and relieve pressure on the main drain pipe and the cross-drain it intersects;
- The in-place lining of the 10-inch metal drain pipe in the west abutment to prevent future corrosion;

- The addition of a berm to the toe of the dam to increase its stability;
- The installation of a series of ten pressure relief wells near the dam's toe into material above the bedrock, and in the bedrock itself, to release artesian pressure from below the dam embankment;
- The addition of new drains and a collection system at the dam toe to collect seepage from the dam embankment and foundation; and
- The repair and rehabilitation of 90,000 square feet of clay blanket that extends upstream from the dam along the east abutment. Seepage has managed to work its way around the dam due to holes in the clay blanket that have developed over time, most likely due to years of seasonal freeze-thaw cycles. The holes in the clay blanket, or liner, have been repaired and additional clay added and covered with a thick layer of soil before the reservoir was re-filled.
- the installation of a remote monitoring and early warning system.

Status

The rehabilitation and repair of East Fork Dam reached substantial completion in January, 1997, and the reservoir was filled to capacity by late June, 1997. The total cost of the repairs and rehabilitation is estimated to be approximately $1.9 million. The Flint Creek Water Users (FCWUA) borrowed $1 million from the state with a 20-year term. FCWUA also contributed their entire emergency reserve fund of $60,000 to the project. The state contributed $788,302, which included $102,716 in interest earnings from the Water Storage Special Revenue Account, $110,000 from the Governor's Environmental Contingency Fund, $478,800 from the state's Hydropower Earnings Account, a $91,786 emergency RRGL grant, and a $5,000 RRGL in-kind matching grant.

Summary

The rehabilitation and repair of East Fork Dam reached substantial completion in January, 1997, and the reservoir was filled to capacity by late June, 1997. The dam was closely monitored during its first filling and throughout the first year of operation. All measurements and observations indicate that the dam is performing well.

A state-of-art remote monitoring / emergency warning system was installed in the summer of 1997. The data from the system is recorded on an Internet page which is automatically updated each day. A lightning strike interrupted the system temporarily in July, 1998. Re-design and remodeling of the system to reduce its vulnerability to lightning strikes is underway. The project meets the first and second priority criteria in the water storage statute: It resolves a threat to life and property posed by a high-hazard facility in unsafe condition, and improves or expands an existing storage facility.

Tin Cup Lake Dam Repair and Rehabilitation

Tin Cup Lake Dam is located at the headwaters of Tin Cup Creek, near the Montana-Idaho border, approximately 14 miles southwest of Darby, Montana. The dam is located within the Selway-Bitterroot Wilderness Area of the Bitterroot National Forest and is owned by the Tin Cup County Water District.

Description

Tin Cup Lake Dam is an earth embankment structure 25 feet high. The dam has a crest width of 10 to 17 feet and a crest length of 437 feet. The dam has an active storage capacity of 2,420 acre-feet. The total storage capacity, to the dam crest elevation, is 2,800 acre-feet.

The primary purpose for the dam is to store water for irrigation and supplement the natural creek water supply during late summer. The dam supplies irrigation water to approximately 1,300 acres of farmland. Additional benefits of the dam include limited flood control and enhancement of instream flows for fisheries, public recreation opportunities, and improved water quality through the control of streambank erosion and stream sedimentation.

Background

Several modifications to the dam have been made since 1906 when it was originally constructed. However, the active storage of the dam has not been increased over the years. The Tin Cup Water Users Company, an organization of 54 local farmers and ranchers, recently formed a public water district.

Status

Tin Cup Lake Dam was inspected by the U.S. Army Corps of Engineers (Corps) in 1980 under the National Dam Inspection Program. The dam was classified as *high-hazard* by the Corps, the U.S. Forest Service, and DNRC due to the potential for loss of human life in the event of dam failure. At least four residences, several private, county, and state roads, bridges and utilities, and several hundred acres of agricultural land would be adversely impacted if the dam failed. The Corps further determined the dam to be *unsafe* because of inadequate spillway capacity to route the probable maximum flood. The USFS will ultimately determine what spillway capacity is required.

Implementation Strategy

The Tin Cup Water Company contracted with the consulting engineering firm of Druyvestein, Johnson and Anderson to bring the dam into compliance with current dam safety standards. Construction and engineering costs totaled $280,742. The following steps were taken to address compliance with safety standards:

1) The dam core was investigated in the fall of 1996 using remote testing methods since it would be impractical to get drilling equipment to the wilderness site. Nothing irregular was detected in the core.

2) Construction to repair or replace the inlet and outlet works was done during the fall of 1997. Work included lining the existing stone and mortar box culvert and replacing the existing log tower and inlet crib.

Additional emergency repair work was needed during rehabilitation:

1) A substantial downstream leak in the downstream toe of the dam was discovered in early spring of 1998, during preparations for installation the inlet section of the newly-installed outlet pipe. The water users association initiated lowering of the reservoir level to a safe level.

2) The U.S. Forest Service took over emergency work since the water district did not have the resources necessary to complete the work and provide a safe, long-term solution. Emergency actions included lowering the spillway to safely evacuate water caused by extreme storm events, and repairing the existing earth-fill section of the dam and the downstream leak.

3) The volume of water stored behind the dam was reduced by two-thirds. The water district is now addressing the issue of the substantial, unanticipated costs associated with the emergency repair work.

Summary

The dam, as modified by the emergency work is now in safe condition, but presently can store only about one-third as much water as it could prior to the 1998 emergency repair. The water district is currently evaluating its financial position with respect to future plans for Tin Cup Dam and the substantial and unanticipated cost of the emergency repair work. The Tin Cup County Water and Sewer District application to the RRGL Program for a grant to restore of the Tin Cup Dam is currently ranked 57th.

Willow Creek Dam Repair

Willow Creek Dam is located in Lewis and Clark County, near the town of Augusta, approximately 55 miles west of Great Falls.

Description

The dam, which is a feature of the Sun River Irrigation Project, is owned by the U.S. Bureau of Reclamation and operated and maintained by the Greenfields Irrigation District. The Fort Shaw Irrigation District also uses water stored in Willow Creek Reservoir through a separate agreement between the districts which addresses operation and maintenance.

Since its construction in 1911, Willow Creek Dam has been raised twice: two feet in 1917, and 14 feet in 1941. The reservoir capacity is 32,300 acre-feet of water at the top of the active conservation pool. The earth-filled dam has a structural height of 93 feet and a crest length of 650 feet. The dam's spillway, located approximately 3,600 feet north of the dam, is comprised of a 700-foot long concrete grade control sill. The outlet works consists of a 54-inch diameter concrete-lined tunnel through the right abutment of the dam, and has a release capacity of 500 cubic feet per second (cfs).

Background

On June 28, 1996, a large sinkhole, measuring twenty feet in depth, three to six feet in diameter at the surface, and about 18 feet in diameter at the bottom, was discovered in the crest of the dam. The sinkhole was located directly above the outlet works tunnel and about fifty feet downstream of the regulating gate. Reclamation and Greenfields personnel initiated temporary emergency repairs to the dam to prevent additional loss of embankment material, which would have further threatened the integrity of the structure.

Repairs included plugging and patching holes in the outlet tunnel, excavating and shaping the sinkhole in preparation for backfilling, and filling the sinkhole with approximately 200 cubic yards of well-graded sand and gravel. Following completion of temporary repairs, water was released from the reservoir at the rate of 300 cfs to decrease hydraulic load pressure on the damaged structure. Greenfields and Reclamation provided 24-hour surveillance of the dam until a safe reservoir level was reached and the dam was functioning adequately.

Reclamation began repair work in August, 1996 and completed permanent repairs in October of 1997, including reconstruction of the embankment at the sinkhole, foundation grouting, lining a portion of the outlet tunnel, and installing a new air ventilation pipe.

Dam operations records indicate that development of the sinkhole was related to a 1958 collapse of the outlet works tunnel when approximately 50 linear feet of the concrete outlet tunnel, downstream of the regulating gate, was damaged as a result of inadequate air ventilation during a period of high reservoir releases. A large void within the foundation was created around the outlet works following the collapse of the tunnel. Repairs to the dam and its outlet tunnel were performed in late 1958 and early 1959.

Status

Permanent repairs addressing the sinkhole event were completed in October, 1997. Following the completion of the repairs, Reclamation completed a comprehensive evaluation of Willow Creek Dam and identified additional dam safety issues related to seepage and performance of the dam during seismic loading. Additional corrective actions are scheduled to begin in the fall of 1999.

Summary

The large sinkhole in the crest of Willow Creek Dam discovered June 28, 1996 was related to damage sustained to the dam's concrete outlet works tunnel during a period of high reservoir releases in 1958. All repairs to the dam were completed by the fall of 1997, restoring full operational capability to the facility. The total cost estimated for the repair project is approximately $1.9 million.

Fred Burr Lake Dam Rehabilitation

Fred Burr Lake Dam is situated in the Flint Creek Range, above the Town of Philipsburg, in Granite County.

Description

Fred Burr Lake Dam is a municipal water supply reservoir owned by the Town of Philipsburg. The dam is an earthfill structure with a rock masonry core, constructed in 1937. A previous dam had existed at the same site. Currently, the reservoir is the sole source of municipal water for the town. A pipeline extends from the dam to the Town of Philipsburg to convey the municipal water. The dam is classified as *high hazard* and is regulated by the DNRC Dam Safety Program.

Background

In 1996, seepage near the outlet of the dam increased dramatically. The Town of Philipsburg hired MSE/HKM engineering of Butte to investigate the seepage problem. It was subsequently decided that rehabilitation of the dam was necessary since seepage indicated problems with the dam of a potentially serious nature.

Initially, the town planned to apply for project funding in 1999 through the state's Renewable Resource Grant and Loan Program. However, after one year of seepage monitoring revealed that the condition of the dam could be deteriorating, it was decided that rehabilitation of the dam should proceed as soon as possible. Philipsburg obtained $30,000 in emergency grant assistance from DNRC, and a $170,000 loan from a local bank to complete the necessary repairs.

Construction began in late August, 1998 and was completed in early October, 1998. As suspected, the metal outlet pipe was severely corroded, exhibiting numerous dime-sized holes. The rehabilitation consisted of replacing the corroded outlet pipe, installing new gate valves, and reconstructing the spillway. Mungas Construction of Philipsburg was the contractor. The final total cost of the repair and rehabilitation project was $284,384.

Summary

Fred Burr Dam now meets the applicable standards of the Montana Dam Safety Act and should perform well far into the future.

Storm Lake Dam Rehabilitation

Storm Lake Dam is located high in the Pintlar Mountains, southeast of Georgetown Lake, in Deer Lodge County.

Description

Storm Lake Dam is an earth and rock-fill dam built in 1898. It is currently owned by the City of Butte, and will eventually be used to supply industrial water to the Butte / Silver Bow area.

Background

Storm Lake Dam is classified as a *high hazard* dam and is regulated by the DNRC Dam Safety Program. In order to meet current safety standards, rehabilitation of the dam was necessary. MSE/HKM, Inc., of Butte was hired by the City/County government of Butte/Silver Bow to perform design work and oversee construction.

Status

Construction began in late August, 1998 and was completed in early October, 1998. Rehabilitation included installation of an upstream valve to the outlet works, and replacement of the downstream valve. The spillway was also reinforced, and several monitoring devices were added.

Summary

Storm Lake Dam now meets applicable standards of the Montana Dam Safety Act.

Silver Lake Dams Rehabilitation

The Silver Lake Dams are located in Deer Lodge County, just east of Georgetown Lake, at the base of the Pintlar Mountains.

Description

The Silver Lake Dams consist of two earth-fill dams built in 1902 and enlarged in 1918. The reservoir can store 13,000 acre-feet of water. The dams are owned by the city-county government of Butte-Silver Bow.

Background

The reservoir supplies industrial water to the City of Butte. The West Silver Lake Dam is classified as *high-hazard*, and is regulated by the Montana DNRC Dam Safety Program. The East Silver Lake Dam is not classified as high hazard. The Silver Lake Dams had several safety deficiencies. As a result, a restriction was placed on the amount of water stored in the reservoir.

Strategy

In order to address the safety deficiencies and maximize reservoir storage capacity, rehabilitation of the dams was necessary. MSE/HKM, Inc., of Butte was retained by Butte-Silver Bow to perform design work and oversee the rehabilitation project. The rehabilitation to the west dam consisted of reconstructing the dam embankment and the addition of a seepage control system. Other work included re-shaping the overflow emergency earthen spillway, and rehabilitating the water delivery flumes near the east dam. Additional spillway capacity was also provided.

Summary

Construction was completed in August of 1997. Silver Lake Dam now is operating at full capacity and dam performance is currently being monitored closely.

Isaacs Creek Dam Repair

Isaacs Creek Dam is owned by the Little Beaver Creek Ranch and is located west of Missoula in the Nine Mile Creek drainage. The dam is 40 feet in height and its reservoir capacity is 175 acre-feet. The privately-owned facility supplies water for irrigation, livestock, and the fishery.

Background

Isaacs Creek Dam is classified as a *high-hazard* dam, since its failure has the potential to cause loss of human life. Several homes and U.S. Forest Service Nine-Mile Ranger Station, consisting of offices and barns, lie in the path of the reservoir's contents, should the dam fail.

Status

Recent investigations of the facility included photography of the inside of the corrugated metal outlet pipe. The photographs revealed that rust corrosion of the pipe over time had resulted in deterioration, including holes. The dam's corrugated metal outlet pipe was completely removed and replaced during early spring of 1997 at a cost of $50,000.

Summary

The Isaacs Creek Dam is now in compliance with provisions of the Montana Dam Safety Act.

Northern Pacific Reservoir Dam Rehabilitation

Northern Pacific Reservoir Dam is located south of East Helena in the foothills of the Elkhorn Mountains in Jefferson County.

Description

The Northern Pacific Reservoir Dam was built in the late 1800's and later modified in the early 1930's. It is a concrete dam capable of storing 150 acre-feet of water. The dam is currently owned by ASARCO, Inc.

Background

The Northern Pacific Dam is classified as a high-hazard dam and is regulated by the DNRC Dam Safety Program. An analysis of stability has been completed for the dam, as part of the operation permit renewal process. The analysis indicated that the dam does not meet state dam safety standards under an extreme flood event or large earthquake scenario. Rehabilitation of the dam would be necessary to bring the project into compliance with current standards. To address the present safety concerns, ASARCO was required to open the dam outlet gates and partially drain the reservoir until a rehabilitation plan for the dam is developed.

Status

The tentative plan is to rehabilitate the dam, although the option of removing the dam has not been ruled out. A rehabilitation plan will be developed before the year 2000.

Big Sky County Wastewater Storage Pond Dam Rehabilitation

The Big Sky County Wastewater Storage Pond Dams are owned by the Big Sky County Water and Sewer District, and are located in the community of Big Sky's Meadow Village, in Gallatin County.

Description

The Big Sky County Wastewater Storage Ponds are large-capacity ponds intended to hold the accumulation of wastewater generated over the winter months until spring, when the water is used for sprinkler irrigation of the golf course and related grounds. Pond Number 1 has a capacity of 60 million gallons and Pond Number 3 a capacity of about 20 million gallons.

Background

The Big Sky wastewater ponds are classified as high-hazard and are regulated by the Montana Dam Safety Program, since they are large-capacity and overlook State Highway 64, as well as a number of residential structures. The wastewater ponds are part of a large project design to meet the wastewater disposal needs of the growing resort community of Big Sky and replaced the old wastewater ponds, which were in poor condition and leaking.

Status

The Big Sky County Wastewater Storage Pond Dams were completed in the fall of 1997. Construction of the new ponds was funded partially by the State Revolving Fund, administered by the Montana Department of Environmental Quality. Engineering for the new ponds was provided by C & H Engineering of Bozeman.

Summary

The wastewater storage ponds are currently in use and appear to be performing satisfactorily.

Wallace Creek Dam Removal

Wallace Creek Dam is located on Wallace Creek, a tributary to the Clark Fork River, in Missoula County.

Background

The privately-owned dam was built in 1922 and was used for irrigation and stock-watering. The need for stored water diminished over the years as irrigated lands were subdivided.

Strategy

The dam owner decided that removal was the best alternative to eliminating the hazard to the many houses located downstream of the reservoir.

Summary

Wallace Creek Dam was removed in the summer of 1997. The Natural Resource Conservation Service provided engineering services for the project.

State Dam Rehabilitation Engineering Design Development Proposals

DNRC is proposing an in-depth engineering design analysis of alternatives for the rehabilitation of two state water projects, Bair Dam in Meagher County and Nevada Creek Dam in Powell County. DNRC's State Water Projects Bureau is requesting $550,000 in funding from the Water Storage Special Revenue Account and the 1999 Legislature, through the executive planning process. DNRC's proposal includes $470,000 from the Water Storage Special Revenue Account and $80,000 from the State Hydro-power Earning Account.

Both dams are classified as *high-hazard*, since structural failure at either project could result in loss of human life, and *unsafe,* since the dam spillway at each project does not meet interim standards under the Montana Dam Safety Act. DNRC is planning to have the study funding in place to coincide with the Dam Safety Program's adoption of new standards for dam spillway design in the Spring of 1999.

Bair Dam Rehabilitation Analysis

Bair Dam is located in Meagher County near the town of Checkerboard, on the North Fork of the Musselshell River.

Status

The dam spillway is in poor condition structurally and is not capable of routing the required inflow design flood for a dam of its size and hazard classification. The dam is a *high hazard* structure, which means that the failure of the dam could cause loss of life. Although the spillway design standards are still being developed, the spillway at Bair Dam does not meet the proposed standard. A permanent reservoir storage restriction has been implemented (since 1997) until the spillway can be rehabilitated.

Strategy

A Engineering analysis is being proposed to examine the dam and spillway so that the most economical rehabilitation alternative can be developed. The analysis will be contracted to a private consulting engineer.

Summary

The estimated cost to complete the feasibility analysis for Bair Dam is $250,000. The funding for this project was requested through the EPP process to the 1999 Legislature.

Nevada Creek Dam Rehabilitation Analysis

Nevada Creek Dam is located in Powell County near the town of Helmville, on Nevada Creek. The dam is owned and regulated by the State of Montana.

Status

The spillway is in very poor condition and may not be able to safely route the current required inflow design flood for a dam of its size and hazard classification. The dam is a high hazard structure, which means that the failure of the dam could cause loss of life. The spillway needs significant structural improvements or replacement.

The Nevada Creek Dam will require geo-technical analysis to address stability and seepage concerns. The dam is located in seismic zone #3, which means that there is a chance that the dam could undergo severe shaking from a major earthquake. A stability analysis of the dam has not been performed. There is uncontrolled seepage exiting from both abutments and there is water flowing from the embankment toe drain. There has been some slumping of the mortared rock outlet stilling basin training wall, which indicates that there may be some piping of the back fill material from behind the wall.

Strategy

A in-depth engineering analysis is being proposed to examine the dam embankment stability and seepage, and the spillway so that the most economical rehabilitation alternative can be developed. The analysis will be contracted to a private consulting engineer.

The estimated cost to complete the engineering design analysis for Nevada Creek Dam is $300,000. The funding for this project was requested by DNRC from the Special Water Storage Revenue Account, through the EPP process, to the 1999 Legislature.

New Storage Project Proposals

There is one proposed storage project on hold pending a decision on the part of the applicants, and one proposed storage project currently under study.

Big Lake Creek Reservoir Study

The proposed project site is located approximately 14 miles south and 11 miles west of the town of Wisdom in the Big Hole River Valley. The site is located at Twin Lakes, in the Beaverhead National Forest. The lakes are supplied by Big Lake Creek, which is a perennial stream originating on the Continental Divide and running northeasterly to its confluence with the Big Hole River less than one mile west of Wisdom.

The Twin Lakes are comprised of an upper lake of approximately 72 surface acres, and a lower lake of approximately 10 surface acres. The lakes are joined together by a shallow, narrow passage, which flows from the upper lake into the lower lake. The proposed dam would be built across the passage to store additional water in the upper lake.

The dam would measure about 1300 feet in length and 20 feet in height, increasing water depth in the lake by about 12 feet and impounding an additional 1000 acre feet of water. The surface acreage of the upper lake would increase to about 110 acres. An initial preliminary cost estimate of the project was $2.25 million.

Background

The Big Hole Watershed Committee is a group of concerned ranchers, fishing guides and conservation group representatives assembled to address issues within the Big Hole River basin. One of the major focal points of the committee is seasonal low streamflow, which impacts the fluvial arctic grayling in the Big Hole River. The river reach near Wisdom has been identified by Montana DFWP biologists as crucial for survival of the species.

Since 1996, the Committee has been exploring the possibility of building a storage project to provide water for flow augmentation in the river during periods of low flow. During years of adequate streamflow, the stored water may be used to augment irrigation operations.

Although this site is ideally located to augment flows in the critical area of the Big Hole River, there are numerous environmental concerns associated with the site. The lakes host a population of lake trout which some biologists feel could be native to the drainage. There is also a population of western boreal toads living along the perimeter of the lakes, which may be impacted by a storage project. A dam would cause stored water to inundate a large wetland area at the head of the existing lake. This could require extensive mitigation efforts and add greatly to the project cost.

Status

In July, 1998, a geologist from the U.S. Bureau of Reclamation conducted a preliminary reconnaissance visit to the Twin Lakes site. A report of the visit detailed concerns about the suitability of the site for a storage project. One observation noted that surface materials appeared too coarse for use in dam construction, and that necessary materials would have to be brought in from different source areas. This would greatly add to the project cost. Reclamation has concluded that without an exploratory drilling program, which would reveal the underlying geology of the area, it cannot make a determination as to the feasibility of the site.

In response to the preliminary report, the committee has contacted Senator Conrad Burns' office to request a federal appropriation to fund the drilling investigation, which is estimated at $73,000. Senator Burns has responded by requesting that the committee solicit opinions concerning this project from several other interested conservation groups.

In Fall 1998, Montana DFWP biologists will submit lake trout samples for genetic testing to determine whether they are planted or native species.

Summary

The Big Lake Storage Project could provide water to augment low flows which negatively impact fluvial arctic grayling in the Big Hole River near Wisdom. During times of adequate streamflows, the stored water could be used to augment irrigation withdrawals. However, there are several environmental concerns which must be addressed as part of the pre-feasibility study process.

Ruby Creek Water Storage Study

The site proposed for the Ruby Creek Reservoir is located on Ruby Creek 10 miles west of Wisdom, Montana and two miles east of Big Hole Pass and the Montana-Idaho border. A pre-feasibility study was conducted by DNRC with assistance from the U.S. Bureau of Reclamation's Montana Projects Office, and the cooperation of upper Big Hole Valley irrigators and Montana DFWP. The applicant is the Ruby Water Company of Wisdom.

Description

Ruby Creek originates along the Continental Divide on the east side of Big Hole Pass in the Beaverhead National Forest. Several small tributaries join Ruby Creek above the proposed impoundment area, which is located at an elevation of 6664 feet above sea level. Ruby Creek historically provides irrigation water for native hay crops on several ranches in the upper Big Hole River Valley.

The proposed dam would measure 60 feet in height, 2100 feet in length, and would impound about 4,000 acre-feet of water, creating a reservoir surface area of 180-200 acres. The project would supply supplemental water to 1,000 acres of irrigated lands and a firm yield of water to Swamp Creek, spawning habitat for the fluvial arctic grayling.

Swamp Creek is a primary spawning stream for the only remaining native population of river-dwelling arctic grayling in the contiguous 48 states. Water from Ruby Creek can be diverted to Swamp Creek via a small irrigation canal that transverses the gentle divide between the drainages of Ruby and Swamp Creeks. The fluvial arctic grayling is listed as a "species of special concern" by Montana DFWP.

Background

The Natural Resources Conservation Service studied the feasibility of a water storage project at this site in the late 1960's. In 1968, a report to the present applicants indicated that the cost of a 60-foot high dam storing 3600 to 4000 acre-feet of water would be approximately $300,000. The project was not pursued because the applicants were unsuccessful in negotiating a land trade with the USFS for a portion of land that would be inundated by the reservoir.

The 1991 Montana Legislature granted the applicants a water development grant of $14,708 to conduct a feasibility study of the proposal. The applicants met with representatives of DNRC, DFWP, USFS, and the Bureau of Reclamation in August 1993 to visit the project site and to plan the studies needed to determine economic and hydrologic feasibility. The project site lies on USFS land, and a small population of westslope cutthroat trout, another Montana DFWP species of special concern, resides in the upper reaches of Ruby Creek and its tributaries.

The U.S. Bureau of Reclamation conducted a water availability study in 1994-96, under its Technical Assistance to States Program. A network of five stream gauging stations was activated to gather streamflow data on Ruby and Swamp Creeks and three canal locations. The flow data was used to develop a hydrologic model for the Ruby and Swamp Creek basins. The 1994 flow data and model conclusions were presented in a draft report titled, "*Ruby Creek Water Availability Study Near Wisdom, Montana.*" The 1994 report indicated that sufficient water may be available for the project.

The decision was made to collect additional streamflow and water supply data through the 1996 water year, since an adequate period of record had not been established for the site. With the completion of the 1996 water year, Reclamation removed the data recorders from the streamflow gauging network. In the fall of 1996, Reclamation had the Ruby Ditch placed on the National Register of Historic Places.

Status

DNRC began a pre-feasibility analysis of the project in fall of 1996. Water supply data collected by USGS and Reclamation between spring of 1994 and fall of 1996, was modeled for the project analysis. Using Reclamation's "Construction Cost Index," the cost to build the reservoir was estimated at $1.2 million. DNRC presented the project applicants with the results of the pre-feasibility study for the Ruby Creek storage proposal in 1997.

A search of mining claim ownership on the National Forest conducted by the Land and Mineral Division of the Bureau of Land Management in 1996 revealed a complex pattern of overlying mineral claims in the area of the proposed dam and impoundment area. The Forest Service and DNRC apprised the applicants of the public notice requirements associated with notifying registered owners of patented mineral claims.

Summary

The Ruby Creek Storage proposal is currently inactive. The project applicants must decide whether to pursue the initiative in light of the complexity of the land ownership issues related to the project site. The project would serve to preserve the land use patterns and ownership in the upper Big Hole Valley and would provide supplemental irrigation water to area irrigators. The project may provide long-term protection of spawning and rearing habitat for the last riverine native arctic grayling population in the contiguous forty-eight states, and may provide similar benefits for local populations of native westslope cutthroat trout. Finally, the project would provide additional recreational opportunities to users of public lands in the upper Big Hole River Valley.

V. Seepage Monitoring for High-hazard Dams

Montana is home to 3,519 dams that each impound over 50 acre-feet of water. Most of these earth-filled dams were built 40 to 80 years ago and have no provision for control or monitoring of seepage. Today, earth-filled dams are designed with seepage control structures to limit the passage of seepage through the dam. By carefully monitoring seepage through dams, problems can often be identified prior to the development of an emergency situation.

A dam seepage-monitoring program is in progress for all state-regulated, high-hazard dams. Seepage monitoring plans will eventually be developed and implemented for all high-hazard dams in Montana located above significant downstream populations.

VI. Seepage Monitoring of State-owned Dams

DNRC manages several state-owned high-hazard dams that do not have adequate seepage control systems. Seepage-monitoring programs at state-owned projects enable DNRC to determine the severity and extent of dam seepage, and whether the integrity of a particular dam is in jeopardy. DNRC is planning to install seepage-monitoring devices in four state-owned dams over the next two years: Deadman's Basin Dam (Wheatland County), Ruby Dam (Madison County), Nilan Dams (Lewis and Clark County), and Cottonwood Dam (Park County).

DNRC's grant request of $100,000 for well-drilling and other seepage monitoring program expenses to the 1999 Legislature is currently ranked 13th in the RRGL Program. DNRC has also applied for $100,000, as a back-up plan, through the Executive Planning Process. The state has recommended a three-phase program, to ensure that all issues are addressed and the most cost-effective approach is taken at each storage project:

Phase I - Currently underway, this phase begins with an intensive field inventory of all dam seepage. In some instances, shallow hand-driven monitoring wells will be installed. Existing data is being carefully reviewed, and recommendations for further data collection and analysis will be made. Cost estimates to implement recommendations will also be determined during this phase. The results of this phase will be published in a report for review and comment.

Phase II - Consists of implementing the recommendations made during the Phase I portion of the investigation. If drilling is necessary, it will be completed during this phase. The water users would be responsible for hiring a driller. DNRC would provide technical assistance on a case-specific basis.

Phase III - will consist of developing methods and procedures to collect and analyze the data on a frequent, long-term basis.

Public safety is not the only justification for implementation of a dam seepage monitoring program. In the event of dam-related litigation, monitoring records provide critical evidence demonstrating that a dam was operated and maintained in a conscientious manner. Finally, maintaining a dam seepage monitoring program demonstrates that a certain "standard of care" is exercised by dam owners and regulators on behalf of the public.

VII. Dam Spillway Standards

DNRC's Dam Safety Program is in the process of proposing new risk-based dam spillway standards. A risk-based standard requires the dam owner to design the spillway according to the expected loss of human life at risk due to habitation in the path, or downstream, of the reservoir in the event the dam fails. A dam that exposes a large downstream population to risk is accordingly held to a higher design standard than a dam located in a rural area with relatively few humans exposed to danger should a dam fail. The new standard will be a follow-up implementation of the results of the *Extreme Storm Event Study* which was funded by the 1993 Legislature and the U.S. Geological Survey.

In May, 1997, a committee of dam owners, regulators, engineers, scientists, and public officials was convened to discuss the various issues related to adoption of a new standard. A group of hydrologists from DNRC was assigned to assist the committee in performing technical evaluations of various options. In May, 1998, the committee agreed upon a draft standard.

The Dam Safety Program is now in the process of holding public meetings to collect public comment on the proposed standard. The economic impact of the new standard is currently being investigated. DNRC plans to have the new standard in place in the Spring of 1999. For more information regarding the new spillway standard, please contact the DNRC Montana Dam Safety Program at (406) 444-6613 or 444-6664.